The Heisenberg Energy Partition: Its Role In Evolution

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Abstract
On the assumption that the Cosmos is a single complex energy system, the unified representation of the evolution of material systems presents itself as an important objective of the science of matter. In this short essay, a sketch of the *evolutionary mechanism* is proposed and the conditions for its extension to human systems adumbrated. The originality of the paper resides in the identification of the main pattern of dynamical relations that repeats itself in the evolution of natural systems and in the identification of the principal evolutionary step, the QMS. The principal constraints responsible for its limitations are also briefly identified.

Keywords: *Energy* (radiation, topologies, partitions, domains), *Symmetry* (Lie Groups), *Cosmic Radiation*, *Externality Condition*, *Modality* (of Fields and of Matter)

Introduction

An underlying assumption of the scientific enterprise is that Nature, seen from within, is a single but complex whole to be represented as such. In the case of the *science of matter*, this assumption has been reinforced by the remarkable scope and success of its language, an interpreted mathematical syntax, *quantum mechanics*. Viewed in that global perspective, the science of material systems is a *science of evolution*, material systems being the only observable entities in space-time.

Thus a unified representation of evolution is an important objective of the science of matter. In this short essay, a sketch of the *evolutionary mechanism* is proposed and its extension to human systems adumbrated. The originality of the paper resides in the identification of the pattern of relations that repeat themselves in the evolution of natural systems, and in the identification of the principal evolutionary step, the QMS.

The essay begins with a prelude in which some key notions are defined in a way

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intelligible to a scientific multidisciplinary audience not necessarily specialised in this area. The second part is focused on the basic quantum process of evolution, always repeated, introduced by way of the *locality* of material systems in space time and on its dependence on the local energy profile. The third part lists some of the principal constraints which orchestrate the diversification of material systems spun out along the cosmic energy gradient, and impose limits to the human science of matter. A brief postlude gives reasons for the abstractness of the essay, and for the two processes of energy transformation needed in this context. The short list of references should be helpful in guiding the reader to readily accessible literature {1}.

(I) PRELUDE

(I.1) SOME USEFUL NOTIONS:

The *Hot Bang,* the birthing event of the universe some 14. 10^9 years ago, denotes a sustained burst of radiant energy (the so-called 'fire ball'). The source of this cosmic energy is referred to as the *Quantum Vacuum* (Q.V.). The Hot Bang is not a directly observable event, but its existence is inferred both inductively from the observed accelerated expansion of the universe, and deductively from some of its predicted consequences {1}.

Energy, the dynamical substrate of nature, is a theoretical notion introduced to account for what is observed. It takes two principal forms: it first appears as a non observable *Radiant energy* (*$\mathscr{E}$-field*) and second as an observable *Material system* (*$\mathscr{E}$-matter*), localised in Space-Time. These two forms of energy are related in two ways:

(a) Presently, matter (*$\mathscr{E}$-matter)* is thought of as a *radiant topology of entangled $\mathscr{E}$-fields* in Space-Time (e.g. String Theory). The experimental evidence supporting this view includes the *materialisation of $\mathscr{E}$-fields* (e.g. interferences, β-decay) and the reverse process of *dematerialisation* (e.g. the dematerialisation of the positronium into two γ rays). The relation between the two forms of energy is also responsible for the transactional energy processes between material systems which behave as energy radiators (e.g. the exchange "forces" of Fermi and Bethe; the Feynman diagrams, etc) {2}.

(b) The functional role of $\mathscr{E}$-fields, which are non-local, is their action on matter whose behavior is observable in energy contexts prepared in Space-Time. This energy transaction is used experimentally to identify material systems in terms of their characteristic properties (mass, spin, etc)

Being observable in space-time, matter is seen to relate to other material systems (including observers), providing the empirical basis on which the science of matter rests. Given the intimate relation of *$\mathscr{E}$-fields* and *$\mathscr{E}$-matter*, a representation of nature *in the evolutionary context* is better expressed in terms of processes of energy transformation than in terms of the behavior of material systems, which is what is to be explained.

(I.2) THE *LOCALITY* OF MATTER:

The *locality* of any material system in space-time is given by its *distinctiveness* in the environmental context in which it is observed. Its dynamical footprints are consequences of the *unitarity* of its behavior in the environment, whic is its *domain of action.*

(I.3) THE STAGES OF EVOLUTION

The *Stages* of the evolution of matter may be viewed as consequences of two conditions: the *oscillatory nature* of the *E-fields* responsible for the behavior of matter, and the *gradient* of the cosmic microwave background radiation (CMBR) that accompanies the expansion of the original fireball, beginning shortly after the onset of the Hot Bang. Its principal stages are the *constructive phase,* triggered by an initial *plasmic phase*, during which the subatomic building blocks of evolutionary matter, the fermions and bosons, were put together. This first stage was followed by the *evolutionary phase* proper, starting approximately $\simeq 3.5.10^5$ years after the Hot Bang, when *neutral matter* became dominant and the universe more transparent. The evolutionary phase continues to this day, as new forms of material systems (e.g. societies, etc) emerge in the domains of action of neutral matter {1}.

The evolutionary phase subdivides into broad energy bands identified by the *forms of behavior* of locally emergent matter (e.g. chemistry, biology (live forms), social organisations, etc). Each of these subphases is further divided into a succession of much narrower energy bands, where the thresholds of *emergence* of *new* of systems are pegged at progressively lower value of the CMBR (whence the arrow of time){3}.

The *dynamical stability of subatomic matter,* created in the *constructive phase*, is generally measured by its *half-life*, a statistical notion related to the *indiscernibility* of individual systems identifiable solely by the characteristics of their type, i.e. protons have no individual name plates.

The *dynamical stability of the neutral matter* that emerges in the *evolutionary phase* is the effect of the *energy* envelope created by the *entangled fields* which form the topological architecture characteristic of its construction. This envelope, the *Heisenberg Energy Partition* (HEP), effectively shields, within specific energy limits, the internal dynamical architecture of the system from the energy fluctuations of its environment..

(II) THE HEISENBERG $\mathscr{E}$-PARTITION

The locality of matter in space time, and the fact that its internal complexification marshals higher energy resources than are needed for its external transactions (i.e. evolution proceeds down the cosmic energy gradient), suggest that the energy partition due to the closure of the internal entangled *$\mathscr{E}$-fields*, the HEP, effectively separates the external *domain of action of the closed unitary system* from the internal *domain of complexification*. While the details of its formation are specific to each type of $\mathscr{E}$-matter, a general pattern has emerged, a characteristic of the quantal macroscopic behavior of *Quantum Macro Systems*: QMS

(II.1) THE QMS

Quantum Macro-Systems were first suspected, but not systematised, in the context of many
body systems found in condensed matter physics {4}. The 'macro' qualifier first appeared in the context of the *behavior* of a large, or macro, system. The search was for the conditions under which a macroscopic variable (i.e. a degree of freedom) could be treated as a quantum variable, i.e. whether the macrosystem could be represented by a Schrödinger equation and sport an energy function ψ suitable to account for its quantum behavior. It was found that three conditions had to be satisfied:

(a) The macroscopic degree of freedom of any complex system ψ must be *largely decoupled* from the internal, i.e. microscopic, degrees of freedom whose overall envelope is to be represented here as φ

(b) The ambient, i.e. external, density of radiant energy must be sufficiently low to make the experimental determination of the eigenvalues of ψ possible;

(c) The behavior of the macroscopic system must be *loosely* controlled by, but not derivable from, the complex dynamical structure of the internal regime of the macro system, i.e. $\varphi \rightarrow \psi$, but $\psi \notin \varphi$

In laboratory systems designed to test the predictions of quantum mechanics, this means that the potential energy of the macro system must be very low, i.e. $V \ll \hbar\omega$. This constraint rules out the possibility of quantum macro systems satisfying these conditions in such $\mathscr{E}$-fields as the gravity and the magnetism ubiquitous on the plane. To test the predictions of quantum mechanics, the macrosystem therefore has to be shielded from its environment to prevent its decoherence.

However, given the contextuality of transactional processes, the dynamical profile of engineered environments are not energetically the same as those in which natural systems complexify, as is evident in the case of living systems{5}. Hence it follows that the above conditions, which were inferred in non natural environments, have to be revised for

observation in natural contexts. Therefore I suggest the following conditions as reasonable ones for *Quantal Macro Systems*, QMS:

(a*) A natural *Quantum Macro System* (QMS) is the terminus of a functionally related series {6} of energy transformations which constitute its historical path, from the Hot bang to the present.

(b*) As a local material system, a QMS is *naturally* limited in space-time by the Heisenberg energy partition that separates its internal domain of complexification from its external domain of action. The empirical evidence suggests that the internal regime of a QMS is made up, in the evolutionary phase, of *cyclical processes* which, in chemical and biological systems, can reach extremely high degrees of complexification, e.g. the metabolic cycle of a cell {6a}.

One of the effects of these processes is the *extraction of energy* from the material systems enslaved by entangled cycles which are formed by the extended transactional processes of energy transformation. This is essential for the energizing of the means of action of the QMS, its macro wave function ψ. When so enabled, ψ transacts energy with external systems of the same modal type (Modal energy fields are *orthogonal* to each other in the evolutionary phase).

In the present context, the notion of *modality* refers to a *phase of the radiant energy* which issued from the QV in the Hot Bang, is the source of the dynamism of all processes in nature, and therefore that of the evolution of matter. Modalised energy should not be confused with the QV itself, an expression which refers to the undifferentiated nothingness out of which the initial burst of radiant energy ignited the universe of which we are a part.

(II.2) THE $\mathscr{E}$- PARTITION

The expression *'Energy partition'* simply denotes the theoretical limit between two distinct energy domains, $\mathscr{E}_i$ and $\mathscr{E}_e$. The outer domain marshals fewer energy resources than the internal one, i.e. $|\mathscr{E}_i| > |\mathscr{E}_e|$, accounting for the modal change across it.

An important property of the Heisenberg *energy partition* is its *opacity* to transactional energy processes (hence to measurements) from either side of it. One of its effects is the *modal difference* between φ and ψ, evident in the break of symmetry between the representation of the φ-behavior and that of ψ-behavior. The *modality* of an $\mathscr{E}$- field is experimentally defined in terms of the symmetry properties of a Lie group representing the behavior of the matter it acts upon.

The opacity of the Heisenberg partition, and the difference between the φ and the ψ modalities, imply that the energizing of the QMS' wave function ψ by its internal resources cannot be attributable to a transactional process, which is unimodal, but to a

transmodal energy transfer. Its mathematical structure, which is not linear, may be related to quantum holography, where sub-atomic processes yield events whose patterns (e.g. in NMRI) belong to different modalities intrinsic to the observer and to the preparation of the domain of observation.

The QMS thus defined is a *unitary* system in its domain of action and is to be treated as a macro particle. The opacity of its energy partition to transactional processes rules out the possibility of reducing the action of the QMS to its inner dynamical structure, this despite the dependence on its own energy on it. The *action of matter*, whose dependence on environmental temperature ($\mathscr{E} \propto aT^4$) is due to its inner topological mechanism, is not to be confused with its internal dynamical regime, i.e. $\varphi \neq \psi$. Every action of a material system is ultimately made possible by energy resources internal to it, but is not reducible to it. Rather, the observable action of a material system is the result of an energy transaction between it, i.e. ψ, and the energy profile of its environment, e.g. ψ^*, which is independent of φ and of the same modality as ψ. These characteristics are direct effects of the opacity of the $\mathscr{E}$-partition.

But if the science of matter is to be the science of cosmic evolution, it has to account for the *diversification* of natural material systems as well {4}. Therefore, the principles that govern the representation of what there is must also cover the modes of *complexification of neutral matter*, which occur in a different energy environment from those that govern sub-atomic matter. The diversification of neutral matter related to the local value of the cosmic microwave radiation (CMR), e.g. to the local temperature, a condition of its dynamical stability that holds true for all quantal matter.

Nature repeats itself, there are no previously unused "mechanical tricks" at its command. Therefore the *diversification* of evolving matter is not traceable to new tricks, but to its emergence in a new energy context. Before life appeared, there were no living forms. The difference between the two evolutionary stages is due in the first instance to the decrease in the ambient density of the cosmic radiation, the consequence of the expansion of the hot bang in space-time. Before the threshold of emergence of living matter was reached, the radiation was too hot for life forms to become dynamically stable: it takes a long time to cool off the cosmos after the initial Hot Bang. Therefore, one should expect the same kinds of patterns to apply to all evolutionary matter, including the evolution of human matter. And, strictly speaking, they do. But there are new kinds of constraints on the representation of the evolutionary processes in this case.

(III) CONSTRAINTS ON THE SCIENCE OF HUMAN EVOLUTION

These constraints are of two types. One is the *opacity* of the *energy partitions*, the other is the *externality condition* in contexts of observation.

(III.1) THE OPACITY OF ENERGY PARTITIONS

Transactional Energy Processes, in the sense of the Fermi-Bethe *exchange forces,* presuppose the similarity of their modal type (gravity is not *exchangeable* with magnetism, i.e. they are *modally orthogonal* in the domain of action of material systems). The main properties of an $\mathscr{E}$- Partition are (a) $|\mathscr{E}_i| > |\mathscr{E}_e|$ and (b) $\varphi \neq \psi$.

(a) $|\mathscr{E}_i| > |\mathscr{E}_e|$ the subscripts refer respectively to the internal and external energy domains separated by the energy partition, itself a singularity in the arrow of time. Thus $\mathscr{E}_i \neq \mathscr{E}_e$

(b) Given the coherence of the entanglement of the $\mathscr{E}$- fields internal to a naturally evolved system {6}, and the overall linearity of their envelope, the *internal dynamical structure* may be represented quantally by a wave function φ, ($\varphi \varepsilon \mathscr{E}i$) and the *unitary* natural system in its domain of action by its wave function ψ, ($\psi \varepsilon \mathscr{E}_e$), with $|\mathscr{E}_i| > |\mathscr{E}_e|$, whence the *orthogonality* of the $\mathscr{E}$- fields and the *transactional opacity* of the $\mathscr{E}$- Partition.

(III.2) THE EXTERNALITY CONDITION.

This condition is a *sine qua non conditio* for the objectivity of experimental results, one of the two pillars of the science of matter, the other being its perspicuous representation by specific mathematical structures, e.g. Lie groups and their associated algebra.

Experimental results are based on observation of *what there is*, namely on sequences of discrete events $\{S_\varepsilon\} = \{\varepsilon_i\}$, whose existence are *givens of nature*, unpredictable and in that sense chaotic. However, the *representation* of what there is, i.e. its mathematical expression, is got by transforming the sequence of *unrelated* discrete events $\{S_\varepsilon\}$ into an *ordered sequence* of *relata* $\{S_\rho\} = \{\rho_i\}$. The *ordering principle* of the events $\{\varepsilon_i\}$ is provided by the human observer, i.e. it is conceptual (or theoretical) and not a given of nature. Ordering bespeaks also of a perspective, or way of looking at the sequence of events $\{S_\varepsilon\}$, an effect of the action of mind.

The (IV) POSTLUDE

The ordering of the discrete set of events $\{S_\varepsilon\} = \{\varepsilon_i\}$, the traces left by transactional processes between the QMS and the $\mathscr{E}$-profile of the environment, is effected by *linear functions*. In the science of matter construed as the science of evolution, these are Lie

groups and associated algebras {7}. In evolutionary systems, the representation of the sequence of relata $\{S_\rho\} = \{\rho_i\}$ results from the projection of the ordering function onto events $\{\varepsilon_i\}$ in a given $\mathscr{E}$-context. As this context is defined by its local $\mathscr{E}$-profile, which is largely dependent on the local cosmic radiation, the *contextuality of observation* brings together the effects of the constraints imposed by the opacity of the energy partitions and by the externality condition.

To which may be added the fact that the *enablement* of the wave function ψ by the *non-linear transmodal energy transfer* across the HEP keeps it distinct from both φ and ψ^*. The difference between unimodal $\mathscr{E}$-transactions and the transmodal transfer function that effect the $\mathscr{E}$-enablement of ψ by φ is extremely complex, and therefore makes this brief essay inescapably more opaque in plain ordinary language.

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